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(71)Applicant : NTN CORP

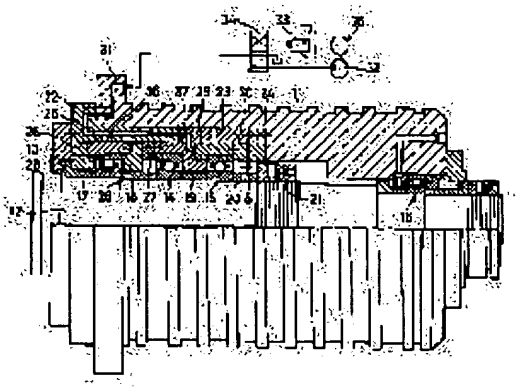
(72)Inventor : MORI MASATSUGU

(54) BEARING PRE-LOAD ADJUSTING MULTIPLE SPINDLE UNIT

(57)Abstract:

PURPOSE: To use in a wode rotation region from a low speed heavy cutting to a high speed light cutting in a single spindle unit.

CONSTITUTION: A spindle 12 running through a housing 11 is supported by a cylindeircal roller bearing 13 and angular ball bearings 14, 15. Identical oil pressure is supplied to both bearings 13, 15 simultaneously, so that pre-preload adjusting of the cylindrical roller bearing 13 and the anglura ball bearings is made at the same time.



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CLAIMS

[Claim(s)]
[Claim 1] The bearing precompression adjustment type spindle unit characterized by supporting a main shaft by the cylindrical roller bearing which an outer ring of spiral wound gasket is shrunk in the direction of a path by supply of a pressure flow object, and adjusts precompression, and the angular contact ball bearing which is made to move a bearing outer ring of spiral wound gasket to shaft orientations by supply of a pressure flow object, and changes axial clearance, enabling a free revolution, and supplying simultaneously the same pressure flow object for precompression adjustment to said cylindrical roller bearing and angular contact ball bearing.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention enables simultaneously adjustment of the amount of precompression of cylindrical roller bearing and an angular contact ball bearing which supports the revolution main shaft of a machine tool, and relates to the high rigidity of a main shaft, and the bearing precompression adjustment type spindle unit which realized improvement in the speed.
[0002]
[Description of the Prior Art] Conventionally, let the spindle of a machine tool be a bearing structure of arrays as shown in drawing 2 in many cases in order to acquire the rigidity of a main shaft. That is, the angular contact ball bearing 4 which arranges the cylindrical roller bearing 3 which supports the load of a radial direction, adjoins it, and supports the load of the axial direction in the location by the side of an anti-work piece in the location by the side of the work piece of the main shaft 2 which penetrates the inside of housing 1 is arranged.
[0003] Each outer ring of spiral wound gasket is pushed on shaft orientations with the presser-foot lid 5, and each above-mentioned bearing 3 and 4 is being fixed to housing 1. Moreover, the cylindrical roller bearing 6 of size smaller than a work-piece side is arranged at the anti-work-piece side of a main shaft 2 in order to escape the bracing of a main shaft 2, and the thermal expansion of a main shaft 2.
[0004] Moreover, the precompression after the nest of each [these] bearing considers as 0 - negative clearance in cylindrical roller bearing 3 and 6, and is aiming at high rigidity-ization of a main shaft 2 as precompression in the angular contact ball bearing 4.
[0005] However, according to the above main shaft structures, at the time of inclusion, each bearing 3 and 4 is [both] in a precompression condition, and already becomes disadvantageous for improvement in the speed of a main shaft 2.
[0006] Where initial precompression of the bearing of such main shaft structure is enlarged, as an approach of accelerating a main shaft 2, the adjustable device of bearing precompression was needed, and for this reason, these people proposed the device which makes bearing precompression adjustable by the feeding and discarding of a pressure flow object by Japanese Patent Application No. No. 101039 [one to], and Japanese Patent Application No. No. 174018 [five to].
[0007]
[Problem(s) to be Solved by the Invention] By the way, the above-mentioned precompression adjustable device corresponds separately respectively to an angular contact ball bearing and cylindrical roller bearing, and as shown in drawing 2 , there is a problem that control and a device become complicated and it cannot respond in the spindle structure where these two kinds of bearing 3 and 4 is arranged by the same main shaft 2.
[0008] Then, the technical problem of this invention applies the precompression change technique in which an angular contact ball bearing and cylindrical roller bearing are separate, and is to offer the bearing precompression adjustment type spindle unit which can perform simultaneously the precompression change of these two kinds of bearing.

[0009]
[Means for Solving the Problem] In order to solve the above technical problems, this invention is supported for a main shaft by the cylindrical roller bearing which an outer ring of spiral wound gasket is shrunk in the direction of a path by supply of a pressure flow object, and adjusts precompression, and the angular contact ball bearing which is made to move a bearing outer ring of spiral wound gasket to shaft orientations by supply of a pressure flow object, and changes axial clearance, enabling a free revolution, and adopts the configuration which supplied simultaneously the same pressure flow object for precompression adjustment to said cylindrical roller bearing and angular contact ball bearing.
[0010]
[Function] The precompression of both bearings can be simultaneously adjusted by carrying out the feeding and discarding of the same pressure flow object for precompression adjustment to the cylindrical roller bearing and the angular contact ball bearing which support a main shaft simultaneously, the low-speed high rigidity of a main shaft is acquired by the heavy precompression by supply of a pressure flow object, and it becomes ****** at the time of blowdown of a pressure flow object, and a high-speed revolution of a main shaft is obtained.
[0011]
[Example] Hereafter, the example of this invention is explained based on drawing 1 of an accompanying drawing.
[0012] In drawing 1 , it is supported by two angular contact ball bearings 14 and 15 to which the main shaft 12 which penetrates the inside of housing 11 to shaft orientations is supported by the cylindrical roller bearing 13 to which the location by the side of a work piece supports the load of a radial direction, it is adjoined and the location by the side of an anti-work piece supports the load of the axial direction, and the edge by the side of an anti-work piece is further supported by cylindrical roller bearing 16.
[0013] With the spacers 17, 18, 19, and 20 attached outside a main shaft 12, and the nut 21 fixed to the main shaft 12, each inner ring of spiral wound gasket of the above-mentioned cylindrical roller bearing 13 and angular contact ball bearings 14 and 15 is being fixed to the main shaft 12, after having been positioned by shaft orientations.
[0014] Sequential insertion of an outer case 22, a retaining ring 23, and the locating ring 24 is carried out from a work-piece side at order, inside said housing 11, with the outer case 22 which carried out bolt immobilization, a retaining ring 23 and a locating ring 24 are pushed on shaft orientations, and it fixes to housing 11, and cylindrical roller bearing 13 is incorporated between a main shaft 12 and an outer case 22, and angular contact ball bearings 14 and 15 are located between a main shaft 12 and a retaining ring 23.
[0015] Positioning of shaft orientations is made with the lid 28 in which cylindrical roller bearing 13 carried out bolt ** at the lid 27 and outer case 22 which the outer-diameter side of the spacers 26 and 26 and this ring 25 which the outer ring of spiral wound gasket fitted into the bore of the pressure adjustment ring 25 beforehand, and were inserted in the both-sides end-face section of an outer ring of spiral wound gasket fitted in in the outer case 22, and were made to intervene between retaining rings 23.
[0016] Beforehand, the pressure adjustment ring 25 is formed using the ingredient which can be contracted, and when the condition that an outer-diameter side contacts the bore side of an outer case 22 serves as ****** of cylindrical roller bearing 13 and contacts the shoulder of spacers 26 and 26 at the time of contraction, the amount of heavy precompression is set up.
[0017] An outer ring of spiral wound gasket fits in directly in a retaining ring 23, and one angular contact ball bearing 14 is fixed by the retaining ring 23 at shaft orientations with the lid 27 which carried out bolt **.
[0018] An outer ring of spiral wound gasket fits in in the pressure adjustment sleeve 29 beforehand, and the angular contact ball bearing 15 of another side is being fixed so that 1 body motion may be carried out to this sleeve 29 at a sleeve 29 with the lid 30 which carried out bolt **.
[0019] It fits in so that the pressure adjustment sleeve 29 and the lid 30 fixed to this may become movable to shaft orientations about the inside of a retaining ring 23 beforehand, and between the

locating rings 24 and lids 30 which carried out bolt ** at the retaining ring 23,. clearance delta is formed considerable the bottom beforehand at the pressure adjustment.
[0020] In order to perform precompression adjustment of said cylindrical roller bearing 13 and angular contact ball bearings 14 and 15, The oil pressure path 31 is formed in housing 11, an outer case 22, and a retaining ring 23 in the shape of a free passage. The hydraulic power unit 35 which becomes the housing 11 side-edge section of this path 31 from a pump 32, a pressure control valve 33, and a directional selecting valve 34 is connected. It is made to face so that opening may be beforehand carried out to the outer-diameter side of the pressure adjustment ring 25 by making the middle of the outer case part of this path 31 into the cylindrical-roller-bearing section 36, and the edge located in the part of a retaining ring 23 is made into the angular contact ball bearing section 37, and it carries out opening so that the end face of the pressure adjustment sleeve 29 may be attended beforehand.
[0021] Therefore, precompression adjustment of cylindrical roller bearing 13 and angular contact ball bearings 14 and 15 can use the same hydraulic power unit and the same oil pressure, and can be performed simultaneously.
[0022] The spindle units of this invention are the above configurations, and beforehand, by cylindrical roller bearing 13, a pressure adjustment is shrinking an outer ring of spiral wound gasket in the direction of a path, and changing a radial crevice, and is performed at angular contact ball bearings 14 and 15 by moving the outer ring of spiral wound gasket of bearing 15 to shaft orientations, and changing axial clearance.
[0023] If the high voltage oil generated in the hydraulic power unit 35 is supplied to the cylindrical-roller-bearing section 36 and the angular contact ball bearing section 37 through the oil pressure path 31, in cylindrical roller bearing 13, the oil pressure beforehand supplied to the outer-diameter side of the pressure adjustment ring 25 will shrink this ring 25 and outer ring of spiral wound gasket, and will make a radial clearance small.
[0024] In an angular contact ball bearing 15, the oil pressure beforehand supplied to the end face of the pressure adjustment sleeve 29 moves this sleeve 29 and an outer ring of spiral wound gasket to the shaft orientations on the right-hand side of drawing 1 , and makes small the axial clearance between angular contact ball bearings 14 and 15.
[0025] Thus, if oil pressure is supplied, both cylindrical roller bearing 13 and the angular contact ball bearings 14 and 15 serve as clearance smallness (heavy precompression), and correspond to low-speed high rigidity operation of a main shaft 12.
[0026] On the other hand, when there is no supply of oil pressure, clearance becomes large (******) and both cylindrical roller bearing 13 and the angular contact ball bearing 15 are fit for a high-speed revolution of a main shaft 12. In addition, what is necessary is just to perform turning on and off of this hydraulic pressure supply by operating a directional selecting valve 34 with the signal of a main shaft rotational frequency.
[0027]
[Effect of the Invention] As mentioned above, according to this invention, can perform simultaneously precompression adjustment of cylindrical roller bearing and an angular contact ball bearing which supports a main shaft, and the high rigidity of a revolution main shaft and improvement in the speed are attained, consequently high-speed light cutting processing is attained from low-speed deep cuts with one spindle unit, and it can be used in a broad revolution field.

[Translation done.]

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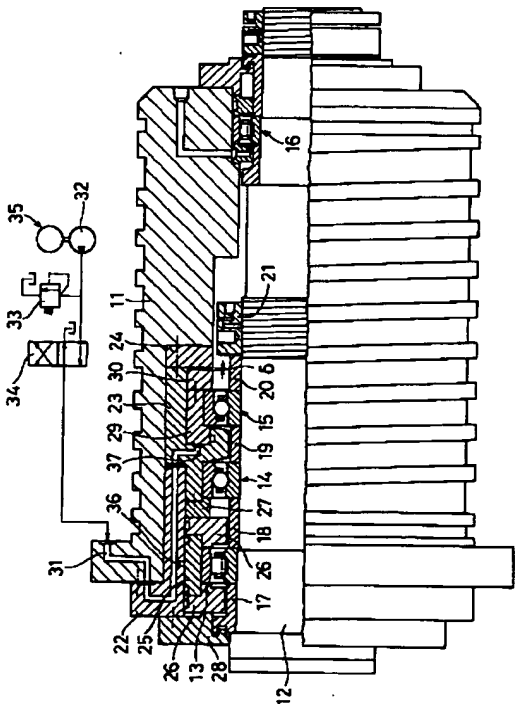
(71)出願人　000102692
エヌティエヌ株式会社
大阪府大阪市西区京町堀１丁目３番17号
(72)発明者　森　正継
四日市市西大鐘町468番地
(74)代理人　弁理士　鎌田　文二　（外２名）

(54)【発明の名称】　軸受予圧調整式主軸ユニット

(57)【要約】
【目的】　一本の主軸ユニットで、低速重切削から高速軽切削加工が可能となり、幅広い回転領域で使用できるようにする。
【構成】　ハウジング１１を貫通する主軸１２を円筒ころ軸受１３とアンギュラ玉軸受１４、１５で支持し、両軸受１３、１５に同一の油圧を同時に供給することにより、円筒ころ軸受１３とアンギュラ玉軸受１４、１５の予圧調整を同時に行なうことができる。



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【特許請求の範囲】

【請求項１】　圧力流体の供給で外輪を径方向に収縮させて予圧を調整する円筒ころ軸受と、圧力流体の供給により軸受外輪を軸方向に移動させてアキシャルすきまを変えるアンギュラ玉軸受とで主軸を回転自在に支持し、前記円筒ころ軸受とアンギュラ玉軸受とに、同一の予圧調整用圧力流体を、同時に供給するようにしたことを特徴とする軸受予圧調整式主軸ユニット。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、工作機械の回転主軸を支持する円筒ころ軸受とアンギュラ玉軸受の予圧量を同時に調整可能とし、主軸の高剛性と高速化を実現した軸受予圧調整式主軸ユニットに関する。

【０００２】

【従来の技術】従来、工作機械のスピンドルは、主軸の剛性を得るため、図２に示すような軸受配列の構造とする場合が多い。即ち、ハウジング１内を貫通する主軸２のワーク側の位置に、ラジアル方向の負荷を支持する円筒ころ軸受３を配置し、それに隣接して反ワーク側の位置にアキシャル方向の負荷を支持するアンギュラ玉軸受４が配置される。

【０００３】上記各軸受３、４は、各々の外輪が押え蓋５により軸方向に押されてハウジング１に固定されている。また、主軸２の反ワーク側には、主軸２の振れ止めと主軸２の熱膨張を逃げる目的で、ワーク側より小さなサイズの円筒ころ軸受６が配置される。

【０００４】また、これら各軸受の組込み後の予圧は、円筒ころ軸受３、６では０～負すきまとし、アンギュラ玉軸受４では予圧として、主軸２の高剛性化を狙っている。

【０００５】しかし、上記のような主軸構造によると、組込時において、すでに各軸受３、４が共に予圧状態にあり、主軸２の高速化には不利になる。

【０００６】このような主軸構造の軸受の初期予圧を大きくした状態で、主軸２を高速化する方法としては、軸受予圧の可変機構が必要となり、このため、本出願人は、特願平１－１０１０３９号及び特願平５－１７４０１８号により、圧力流体の給排で軸受予圧を可変とする機構を提案した。

【０００７】

【発明が解決しようとする課題】ところで、上記した予圧可変機構は、アンギュラ玉軸受と円筒ころ軸受に対して各々別個に対応したものであり、図２に示したように、これら２種類の軸受３、４が同一の主軸２に配列されるスピンドル構造には、制御や機構が複雑となって対応できないという問題がある。

【０００８】そこで、この発明の課題は、アンギュラ玉軸受と円筒ころ軸受の別個の予圧切換え技術を応用し、これら２種類の軸受の予圧切換えを同時に行なえる軸受予圧調整式主軸ユニットを提供することにある。

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【０００９】

【課題を解決するための手段】上記のような課題を解決するため、この発明は、圧力流体の供給で外輪を径方向に収縮させて予圧を調整する円筒ころ軸受と、圧力流体の供給により軸受外輪を軸方向に移動させてアキシャルすきまを変えるアンギュラ玉軸受とで主軸を回転自在に支持し、前記円筒ころ軸受とアンギュラ玉軸受とに、同一の予圧調整用圧力流体を、同時に供給するようにした構成を採用したものである。

【００１０】

【作用】主軸を支持する円筒ころ軸受とアンギュラ玉軸受とに、同一の予圧調整用圧力流体を同時に給排することで、両軸受の予圧を同時に調整することができ、圧力流体の供給による重予圧で主軸の低速高剛性が得られ、また、圧力流体の排出時は軽予圧となり、主軸の高速回転が得られる。

【００１１】

【実施例】以下、この発明の実施例を添付図面の図１に基づいて説明する。

【００１２】図１において、ハウジング１１内を軸方向に貫通する主軸１２は、ワーク側の位置がラジアル方向の負荷を支持する円筒ころ軸受１３で支持され、それに隣接して反ワーク側の位置が、アキシャル方向の負荷を支持する２個のアンギュラ玉軸受１４、１５によって支持され、更に反ワーク側の端部が円筒ころ軸受１６で支持されている。

【００１３】上記円筒ころ軸受１３とアンギュラ玉軸受１４、１５の各内輪は、主軸１２に外嵌する間座１７、１８、１９、２０と、主軸１２に固定したナット２１により、軸方向に位置決めされた状態で主軸１２に固定されている。

【００１４】前記ハウジング１１の内部に、ワーク側から順に、外筒２２と支持リング２３及び位置決めリング２４が順次挿入され、ハウジング１１にボルト固定した外筒２２で支持リング２３と位置決めリング２４を軸方向に押して固定し、円筒ころ軸受１３は、主軸１２と外筒２２の間に組込まれ、アンギュラ玉軸受１４、１５は、主軸１２と支持リング２３の間に位置している。

【００１５】円筒ころ軸受１３は、外輪が予圧調整リング２５の内径に嵌合し、外輪の両側端面部に挿入した間座２６、２６と該リング２５の外径面は外筒２２内に嵌合し、支持リング２３との間に介在させた蓋２７及び外筒２２にボルト止した蓋２８により、軸方向の位置決めがなされている。

【００１６】予圧調整リング２５は、収縮可能な材料を用いて形成され、外径面が外筒２２の内径面に当接する状態が円筒ころ軸受１３の軽予圧となり、収縮時に間座２６、２６の肩部に当接することにより重予圧量が設定される。

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【００１７】一方のアンギュラ玉軸受１４は、外輪が支持リング２３内に直接嵌合し、支持リング２３にボルト止した蓋２７で軸方向に固定化されている。

【００１８】他方のアンギュラ玉軸受１５は、外輪が予圧調整スリーブ２９内に嵌合し、該スリーブ２９にボルト止した蓋３０でスリーブ２９に一体動するよう固定されている。

【００１９】予圧調整スリーブ２９と、これに固定した蓋３０は、支持リング２３内を軸方向に移動可能となるよう嵌合し、支持リング２３にボルト止した位置決めリング２４と蓋３０との間には、予圧調整に相当したすきまδが設けられている。

【００２０】前記円筒ころ軸受１３及びアンギュラ玉軸受１４、１５の予圧調整を行なうため、ハウジング１１と外筒２２及び支持リング２３に油圧経路３１を連通状に設け、該経路３１のハウジング１１側端部に、ポンプ３２と圧力制御弁３３及び方向切換弁３４からなる油圧源３５を接続し、該経路３１の外筒部分の途中を円筒ころ軸受部３６として予圧調整リング２５の外径面に開口するよう臨ませ、支持リング２３の部分に位置する端部はアンギュラ玉軸受部３７とし、予圧調整スリーブ２９の端面に臨むよう開口させている。

【００２１】従って、円筒ころ軸受１３とアンギュラ玉軸受１４、１５の予圧調整は、同一の油圧源及び同一の油圧を使用し、同時に行なうことができる。

【００２２】この発明の主軸ユニットは上記のような構成であり、予圧調整は、円筒ころ軸受１３では、外輪を径方向に収縮させ、ラジアルすき間を変えることで、アンギュラ玉軸受１４、１５では軸受１５の外輪を軸方向に移動させてアキシャルすきまを変えることで行なう。

【００２３】油圧源３５で発生した高圧油を、油圧経路３１を経て円筒ころ軸受部３６とアンギュラ玉軸受部３７に供給すると、円筒ころ軸受１３では、予圧調整リング２５の外径面に供給された油圧が、このリング２５と

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外輪を収縮させ、ラジアルすきまを小さくする。

【００２４】アンギュラ玉軸受１５では、予圧調整スリーブ２９の端面に供給された油圧が、該スリーブ２９と外輪を図１右側の軸方向に移動させ、アンギュラ玉軸受１４、１５のアキシャルすきまを小さくする。

【００２５】このように、油圧を供給すると、円筒ころ軸受１３とアンギュラ玉軸受１４、１５は共にすきま小（重予圧）となり、主軸１２の低速高剛性運転に対応する。

【００２６】一方、油圧の供給がない場合は、円筒ころ軸受１３とアンギュラ玉軸受１５は、共にすきまが大きく（軽予圧）なって、主軸１２の高速回転に向く。なお、この油圧供給のオン・オフは、主軸回転数の信号により、方向切換弁３４を作動させて行なえばよい。

【００２７】

【発明の効果】以上のように、この発明によると、主軸を支持する円筒ころ軸受とアンギュラ玉軸受の予圧調整を同時に行なうことができ、回転主軸の高剛性と高速化が可能になり、この結果、一本の主軸ユニットで、低速重切削から高速軽切削加工が可能となり、幅広い回転領域で使用できる。

【図面の簡単な説明】

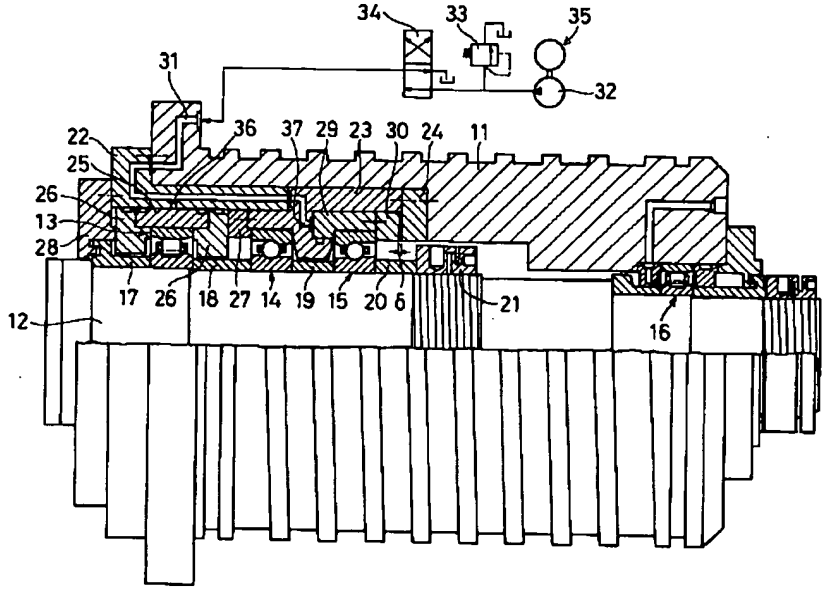
【図１】この発明の軸受予圧調整式主軸ユニットを示す一部切欠正面図

【図２】従来の主軸ユニットを示す一部切欠正面図

【符号の説明】

１１　ハウジング
１２　主軸
１３　円筒ころ軸受
１４、１５　アンギュラ玉軸受
２５　予圧調整リング
２９　予圧調整スリーブ
３１　油圧経路

【図1】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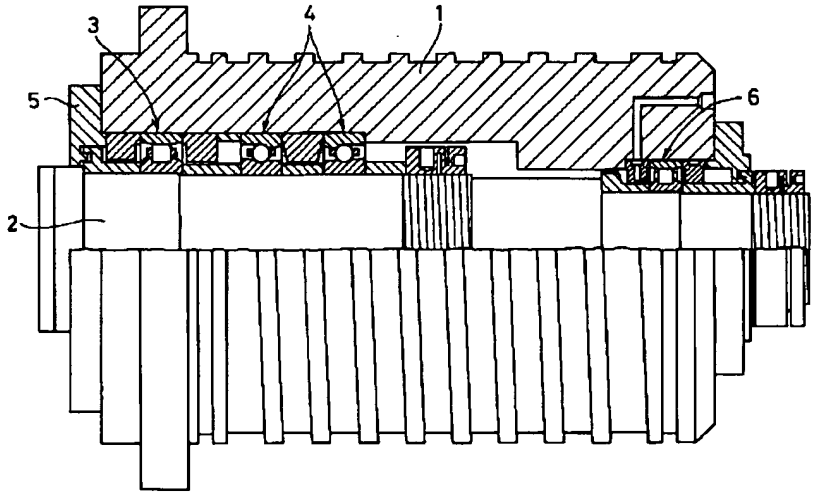
【図2】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